PATENT ABSTRACTS OF JAPAN

(11)Publication number : 07-026994

(43)Date of publication of application : 27.01.1995

(51)Int.Cl. F02D 13/02
F01L 1/34
F02B 29/08
F02B 33/00
F02D 21/08
F02D 21/08
F02D 23/00
F02D 41/02
F02D 41/04
F02D 43/00
F02M 25/07

(21)Application number : 05-167026

(22)Date of filing : 06.07.1993

(71)Applicant : MAZDA MOTOR CORP

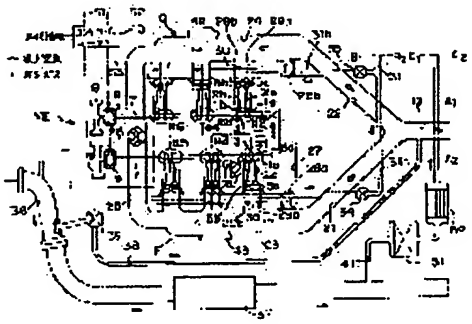
(72)Inventor : SASAKI JUNZO
FUJII MOTOKIMI
TAKAYAMA TAKESHI
UESUGI TATSUYA

(54) INTAKE DEVICE OF ENGINE PROVIDED WITH SUPERCHARGER

(57)Abstract:

PURPOSE: To decrease an exhaust temperature so as to be held to the allowable a limited exhaust temperature or less by providing an EGR control means for enhancing the EGR ratio when the exhaust temperature rises to the prescribed allowable limited exhaust temperature due to an increase in the engine speed.

CONSTITUTION: The fuel injection amounts of first and second fuel injection valves 5a, 5b of respective cylinders 1 to 6 are respectively controlled by a control unit 10. In an engine VE, the control unit 10 suitable controls the opening/closing timing of intake valves 1a, 1b, the EGR ratio, the pressurized air relief amount and the air-fuel ratio on the basis of the engine speed, the S/C discharge temperature and the exhaust



temperature, so as to prevent knocking from being generated in all driving range. Thereby, when the exhaust temperature is raised to the fixed allowable limited exhaust temperature due to an increase in the engine speed during its operation, the EGR ratio is enhanced by enlarging the opening of the second EGR valve 42, and the exhaust temperature is lowered so as to be held to the allowable limited exhaust temperature or less.

LEGAL STATUS

[Date of request for examination]	18.05.2000
[Date of sending the examiner's decision of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	3280758
[Date of registration]	22.02.2002
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] A mechanical supercharger and an inhalation-of-air valve-opening close timing adjustable means by which the clausilium timing of an inlet valve can be changed, Operational status is embraced in the operating range to which supercharge is performed by the mechanical supercharger at least. In the suction system of a mechanical supercharged engine with which the inhalation-of-air valve-opening close timing control means which an inhalation-of-air line controls [control means] an inhalation-of-air valve-opening close timing adjustable means so that an inlet valve sees by the crank angle and is closed to the comparatively late timing after a bottom dead point, and makes inlet-valve ****** operation perform in an engine is established While an inhalation-of-air valve-opening close timing control means makes inlet-valve ****** operation perform in an engine in a predetermined low-speed field When an engine speed goes up from this low-speed field and the discharge temperature of a mechanical supercharger rises to a predetermined tolerance discharge temperature Control an inhalation-of-air valve-opening close timing adjustable means, and inlet-valve ****** operation is made to perform in an engine so that it may be closed to timing earlier than the case where an inlet valve is inlet-valve ****** operation. And the suction system of the mechanical supercharged engine characterized by establishing the EGR control means which raises an EGR rate when an engine speed goes up from the above-mentioned low-speed field and an exhaust-gas temperature rises to a predetermined tolerance exhaust-gas temperature.
[Claim 2] In the suction system of the mechanical supercharged engine indicated by claim 1 After inlet-valve ****** operation was performed by the inhalation-of-air valve-opening close timing control means, The supercharge control means which makes the inhalation-of-air path of a mechanical supercharge style on board relieve the pressurization air of a mechanical supercharger lower stream of a river when an engine speed furthermore goes up and the discharge temperature of a mechanical supercharger rises to the above-mentioned tolerance discharge temperature, The suction system of the mechanical supercharged engine characterized by establishing an Air Fuel Ratio Control means to change an air-fuel ratio into a rich side when an engine speed goes up further and an exhaust-gas temperature rises to the above-mentioned tolerance exhaust-gas temperature, after the EGR rate was raised by the EGR control means.
[Claim 3] The suction system of the mechanical supercharged engine characterized by a mechanical supercharged engine using regular gasoline as a fuel in the suction system of the mechanical supercharged engine indicated by claim 1 or claim 2.
[Claim 4] The suction system of the mechanical supercharged engine characterized by for an EGR control means not supplying EGR in the above-mentioned predetermined low-speed field, but supplying EGR from from in the suction system of the mechanical supercharged engine indicated by any one of claim 1 - the claims 3 when an engine speed goes up from this low-speed field and an exhaust-gas temperature rises to the above-mentioned tolerance exhaust-gas temperature.
[Claim 5] The suction system of a mechanical supercharged engine with which an EGR control means is characterized by the time when an engine speed is higher raising an EGR rate in the suction system of

the mechanical supercharged engine indicated by any one of claim 1 - the claims 4.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the suction system of a mechanical supercharged engine.
[0002]
[Description of the Prior Art] Inhalation air is pressurized with a mechanical supercharger (supercharge), an inhalation-of-air charging efficiency is raised, and the mechanical supercharged engine which aimed at improvement in an output is known conventionally. However, when it supercharges with a mechanical supercharger in this way, there is a problem that knocking becomes easy to take place, at the time of a heavy load. For this reason, although correspondence of carrying out the retard of the ignition timing at the time of a heavy load, and raising an antiknock property etc. is made in this conventional mechanical supercharged engine, since the fall of engine power will be caused if the retard of the ignition timing is carried out, while making the improvement effectiveness in an output by supercharge lose in weight, the problem of reducing the fuel consumption engine performance arises.
[0003] Then, in the engine equipped with the mechanical supercharger and an inhalation-of-air valve-opening close timing adjustable means (VVT) by which the clausilium timing of an inlet valve can be changed, by the predetermined operating range, after raising charge pressure, the clausilium timing of an inlet valve is seen by the crank angle, an inhalation-of-air line is set up at the comparatively late stage after a bottom dead point, inlet-valve ****** operation is performed, and what raised the antiknock property is proposed (for example, refer to JP,63-239312,A). That is, if inlet-valve ****** operation is performed after raising charge pressure, since the effective compression ratio in a compression stroke will usually become small compared with the time of operation, the temperature rise by compression of the gaseous mixture of a combustion chamber becomes small, therefore the temperature of the gaseous mixture at the time of ignition becomes comparatively low, and an antiknock property will be raised.
[0004]
[Problem(s) to be Solved by the Invention] Since an inhalation-of-air charging efficiency is not fully raised in inside and a quantity rotation field, it becomes impossible however, to fully heighten engine power, when performing inlet-valve ****** operation. Therefore, in inside and a quantity rotation field, there is a problem that an antiknock property cannot be raised depending on inlet-valve ******.
[0005] Moreover, in the supercharge region, an inhalation-of-air path is made to flow back by making a part of exhaust gas into EGR gas, and while reducing combustion temperature and raising an antiknock property, the supercharged engine which reduced the NOx yield is also proposed (for example, refer to JP,60-237153,A). However, if EGR gas is introduced into an inhalation-of-air path, since an inhalation-of-air charging efficiency will fall, there is a problem of causing the fall of engine power.
[0006] By the way, in a mechanical supercharged engine, although the discharge pressure (charge pressure) of a supercharger will rise with the rise of an engine speed, therefore the temperature (discharge temperature) of regurgitation air will rise, when a discharge temperature becomes high too much, there is a problem that the dependability of a supercharger is spoiled by thermal expansion etc.

So, when a discharge temperature reaches a predetermined tolerance discharge temperature, he makes the inhalation-of-air path of a supercharge style on board relieve the pressurization air of a supercharger lower stream of a river, and is trying to hold a discharge temperature below to a tolerance discharge temperature in the conventional mechanical supercharged engine. However, when pressurization air is made to relieve in this way, while making power loss with a supercharger increase, there is a problem of it becoming impossible to fully heighten engine power.

[0007] Furthermore, since the dependability of an exhaust pipe or a catalytic converter was spoiled when the exhaust-gas temperature became high too much, although the inclination for an exhaust-gas temperature (temperature of exhaust gas) to become high in a mechanical supercharged engine was strong, when a tolerance exhaust-gas temperature predetermined with the conventional mechanical supercharged engine in an exhaust-gas temperature is reached, an air-fuel ratio is changed into a rich side, and he is trying to reduce an exhaust-gas temperature. However, when it does in this way, there is a problem that the fuel consumption engine performance falls.

[0008] Therefore, in the mechanical supercharged engine, after considering synthetically the closing motion timing of an inlet valve, charge pressure, EGR, an air-fuel ratio, etc., engine power can fully be heightened, raising an antiknock property by all operating range, and the fuel consumption engine performance can be raised, and development of the most rational system that can hold a supercharger discharge temperature and an exhaust-gas temperature in tolerance further is called for.

[0009] This invention aims at offering the mechanical supercharged engine which can be made in order to solve the above-mentioned conventional trouble, can fully heighten engine power, preventing generating of knocking by all operating range, and can raise the fuel consumption engine performance, and can hold a supercharger discharge temperature and an exhaust-gas temperature in tolerance.

[0010]

[Means for Solving the Problem] An inhalation-of-air valve-opening close timing adjustable means by which the 1st invention can change a mechanical supercharger and the clausilium timing of an inlet valve since the above-mentioned purpose is attained, Operational status is embraced in the operating range to which supercharge is performed by the mechanical supercharger at least. In the suction system of a mechanical supercharged engine with which the inhalation-of-air valve-opening close timing control means which an inhalation-of-air line controls [control means] an inhalation-of-air valve-opening close timing adjustable means so that an inlet valve sees by the crank angle and is closed to the comparatively late timing after a bottom dead point, and makes inlet-valve ****** operation perform in an engine is established While an inhalation-of-air valve-opening close timing control means makes inlet-valve ****** operation perform in an engine in a predetermined low-speed field When an engine speed goes up from this low-speed field and the discharge temperature of a mechanical supercharger rises to a predetermined tolerance discharge temperature Control an inhalation-of-air valve-opening close timing adjustable means, and inlet-valve ****** operation is made to perform in an engine so that it may be closed to timing earlier than the case where an inlet valve is inlet-valve ****** operation. And when an engine speed goes up from the above-mentioned low-speed field and an exhaust-gas temperature rises to a predetermined tolerance exhaust-gas temperature, the suction system of the mechanical supercharged engine characterized by establishing the EGR control means which raises an EGR rate is offered. In addition, inlet-valve ****** operation is the meaning of being earlier than the case where the clausilium timing of an inlet valve is inlet-valve ****** operation, and is not the meaning that it is early compared with the clausilium timing of the inlet valve of an ordinary engine here.

[0011] In the suction system of the mechanical supercharged engine which the 2nd invention requires for the 1st invention After inlet-valve ****** operation was performed by the inhalation-of-air valve-opening close timing control means, The supercharge control means which makes the inhalation-of-air path of a mechanical supercharge style on board relieve the pressurization air of a mechanical supercharger lower stream of a river when an engine speed furthermore goes up and the discharge temperature of a mechanical supercharger rises to the above-mentioned tolerance discharge temperature, After the EGR rate was raised by the EGR control means, When an engine speed furthermore goes up

and an exhaust-gas temperature rises to the above-mentioned tolerance exhaust-gas temperature, the suction system of the mechanical supercharged engine characterized by establishing an Air Fuel Ratio Control means to change an air-fuel ratio into a rich side is offered.

[0012] The 3rd invention offers the suction system of the mechanical supercharged engine characterized by a mechanical supercharged engine using regular gasoline as a fuel in the suction system of the mechanical supercharged engine concerning the 1st or 2nd invention.

[0013] In the suction system of the mechanical supercharged engine concerning any one of the 1st - the 3rd invention, an EGR control means does not supply EGR in the above-mentioned predetermined low-speed field, but the 4th invention offers the suction system of the mechanical supercharged engine characterized by supplying EGR from from, when an engine speed goes up from this low-speed field and an exhaust-gas temperature rises to the above-mentioned tolerance exhaust-gas temperature.

[0014] The 5th invention offers the suction system of a mechanical supercharged engine with which an EGR control means is characterized by the time when an engine speed is higher raising an EGR rate in the suction system of the mechanical supercharged engine concerning any one of the 1st - the 4th invention.

[0015]

[Example] Hereafter, the example of this invention is explained concretely. it is shown in drawing 1 and drawing 2 -- as -- the 1- the 6th -- the 6-cylinder V type engine VE equipped with cylinder #1-#6 -- setting -- the 1st bank P side -- the 1st, the 3rd, and the 5th -- cylinder #1, #3, and #5 arrange -- having -- the 2nd bank Q side -- the 2nd, the 4th, and the 6th -- cylinder #2, #4, and #6 are arranged. here -- each -- gas column #1-#6 are lit in order of #1 ->#2 ->#3 ->#4 ->#5 ->#6. therefore, the 1st bank P side -- each -- gas column #1, #3, and #5 -- mutual -- like an inhalation-of-air line -- not overlapping -- moreover, the 2nd bank Q side -- each -- it does not overlap like an inhalation-of-air line mutually [gas column #2, #4, and #6]. In addition, below, for convenience, it sees to the longitudinal direction (drawing 1 longitudinal direction) of Engine VE, 5th cylinder #5 side will be called "left" [near the engine], and 1st cylinder #1 side will be called "right."

[0016] In gas column #1-#6, when the 1st and 2nd inlet valve 1a and 1b is opened, gaseous mixture is inhaled in a combustion chamber 3 from 1st and 2nd suction-port 2a and 2b, respectively. each -- It is lit and burned with the postignition plug (not shown) into which this gaseous mixture was compressed at the piston (not shown), and when an exhaust valve (not shown) is opened, combustion gas (exhaust gas) is discharged by the exhaust air port 4. Here, 1st and 2nd suction-port 2a and 2b are attended, and the 1st and 2nd fuel injection valve 5a and 5b which injects a fuel and forms gaseous mixture into the inhalation air in a port, respectively is formed. in addition, the 3- in drawing 1 -- the 6th -- cylinder #3-#6 -- the 1st and the 2nd -- since it is the same configuration as cylinder #1 and #2, numbering in each member is omitted on account of space.

[0017] although not illustrated in detail -- each -- the fuel oil consumption of the 1st and 2nd fuel injection valve 5a and 5b of gas column #1-#6 is controlled by the control unit 10, respectively. namely, the control unit 10 -- each -- the air-fuel ratio of the gaseous mixture of gas column #1-#6 can be changed now free.

[0018] and the 1st and 2nd bank P and Q -- setting -- ****** -- a gap -- each -- it is opened [the 1st and 2nd inlet valve 1a and 1b of gas column #1-#6] and closed to predetermined timing by the cams 6a and 6b for the 1st and 2nd inlet valve attached in the cam shaft 7 for inlet valves, respectively so that it may explain later. Here, the cam-shaft pulley 8 is attached in the left end section of each cam shaft 7 for inlet valves of the 1st and 2nd bank P and Q, respectively. And although not illustrated, one timing belt is being rolled ranging over both the cam-shafts pulleys 8 and 8 and the crankshaft pulley attached in the crankshaft, and the rotation drive of the cam shafts 7 and 7 for both inlet valves is carried out with a crankshaft synchronizing with this crankshaft.

[0019] Here, to the cam shafts 7 and 7 for both inlet valves, an inhalation-of-air valve-opening close timing adjustable means 9 (this is hereafter called VVT9 for short for convenience) by which these rotation phases can be changed and the closing motion timing of the 1st and 2nd inlet valve 1a and 1b can be changed is established, and these VVT(s)9 are controlled by the control unit 10, respectively. In

addition, since VVT9 can only shift the closing motion timing of the 1st and 2nd inlet valve 1a and 1b in the direction of a tooth lead angle, or the direction of a lag, even when changing closing motion timing, a valve-opening period (seeing by the crank angle) does not change.

[0020] Although not illustrated, it is opened and closed to predetermined timing so that the almost same device as inlet valves 1a and 1b may also explain an exhaust valve later. However, since VVT is not prepared to the exhaust valve, the closing motion timing of an exhaust valve is being fixed.

[0021] In order to supply the air for fuel combustion to gas column #1-#6, the common inhalation-of-air path 12 is formed. Engine VE -- each -- The air cleaner 13 from which it sees in this common inhalation-of-air path 12 in the flow direction of inhalation air, and the dust in inhalation air is removed sequentially from the upstream, The intake air flow sensor 14 which detects an inhalation air content, and the throttle valve 15 which are opened and closed by an accelerator pedal (not shown) being interlocked with, The mechanical supercharger 16 (supercharger) driven with a crankshaft (not shown) and the intercooler 17 which cools the inhalation air to which adiabatic compression was carried out and temperature rose with this mechanical supercharger 16 are interposed.

[0022] And in the downstream, the bypass inhalation-of-air path 18 which makes the part of the downstream open for free passage from the part and intercooler 17 of the upstream is formed by the mechanical supercharger 16 of the common inhalation-of-air path 12 from a throttle valve 15, and the relief valve 20 opened and closed by this bypass inhalation-of-air path 18 with an actuator 19 according to the signal from a control unit 10 is interposed. Here, if the temperature (discharge temperature) of the air breathed out from the mechanical supercharger 16 with the rise of an engine speed approaches a predetermined tolerance discharge temperature, by the actuator 19, a relief valve 20 will be opened, the inhalation air of an intercooler lower stream of a river will be relieved in the style of supercharge on board, and a discharge temperature will be held below at a tolerance discharge temperature so that it may explain later. Here, the tolerance discharge temperature is set as the value used as the limitation that the dependability is spoiled by thermal expansion etc., if the temperature of the mechanical supercharger 16 becomes more than this.

[0023] The common inhalation-of-air path 12 branches from an intercooler 17 by the downstream to the 1st branching inhalation-of-air path 21 and the 2nd branching inhalation-of-air path 22, the down-stream edge of the 1st branching inhalation-of-air path 21 is connected to the 1st surge tank 23 for the 1st bank P, and the down-stream edge of the 2nd branching inhalation-of-air path 22 is connected to the 2nd surge tank 24 for the 2nd bank Q. Here, the 1st free passage way 25 which makes the left end section of the 1st surge tank 23 and the left end section of the 2nd surge tank 24 open for free passage is formed, and the free passage way closing motion valve 26 which opens and closes this is interposed in this 1st free passage way 25. Moreover, the 2nd free passage way 27 which makes the right end section of the 1st surge tank 23 and the right end section of the 2nd surge tank 24 open for free passage is formed, and two free passage way shutter valves 28a and 28b which open and close this are interposed in this 2nd free passage way 27.

[0024] These 1st and 2nd free passage ways 25 and 27, the free passage way closing motion valve 26, and the free passage way shutter valves 28a and 28b are formed in order to raise an inhalation-of-air charging efficiency according to an engine speed, using a mesomeric effect or the inertia effectiveness effectively. Namely, at the time of low rotation, the free passage way closing motion valve 26 and the free passage way shutter valves 28a and 28b are closed. An inhalation-of-air charging efficiency is raised using the mesomeric effect which makes the tee from the common inhalation-of-air path 12 to the 1st and 2nd branching inhalation-of-air paths 21 and 22 the pressure wave pars inflexa. An inhalation-of-air charging efficiency is raised using the mesomeric effect which opens only the free passage way shutter valves 28a and 28b at the time of a middle turn, and makes the center section of the 2nd free passage way 27 the pressure wave pars inflexa. At the time of high rotation, he opens the free passage way closing motion valve 26 and the free passage way shutter valves 28a and 28b, and is trying to raise an inhalation-of-air charging efficiency using the inertia effectiveness.

[0025] and -- the 1st surge tank 23 -- the 1st, the 3rd, and the 5th -- the [3 sets of / for cylinder #1, #3, and #5 / 1st] -- the upper edge of 2 independent inhalation-of-air paths 29a and 29b connects -- having -

- the [these / 1st] -- the down-stream edge of 2 independent inhalation-of-air paths 29a and 29b is connected to 1st and 2nd suction-port 2a of a corresponding gas column, and 2b, respectively. on the other hand -- the 2nd surge tank 24 -- the 2nd, the 4th, and the 6th -- the [3 sets of / for cylinder #2, #4, and #6 / 1st] -- the upper edge of 2 independent inhalation-of-air paths 29a and 29b connects -- having -- the [these / 1st] -- the down-stream edge of 2 independent inhalation-of-air paths 29a and 29b is connected to 1st and 2nd suction-port 2a of a corresponding gas column, and 2b, respectively. here -- each -- the [of gas column #1-#6] -- at the time of a low load, it is closed by 2 independent inhalation-of-air path 29b, respectively, and the inhalation-of-air path closing motion valve 30 which generates a swirl and raises the flammability of gaseous mixture into a combustion chamber 3 is formed. In addition, let 1st suction-port 2a be a tangential type or helical type swirl port.

[0026] each -- the assistant air supply path 31 which supplies the assistant air for promoting evaporation and atomization of a fuel is established in the 1st and 2nd fuel injection valve 5a and 5b of gas column #1-#6, and opening of the upper edge of this assistant air supply path 31 is carried out to it from the throttle valve 15 at the common inhalation-of-air path 12 of the upstream. And the assistant air control valve 32 which is a cross valve is interposed in the assistant air supply path 31, and the assistant air installation path 33 an upper edge carries out [the path] opening to the common inhalation-of-air path 12 of the downstream from the mechanical supercharger 16 is connected to the 3rd terminal of this assistant air control valve 32. Here, while introducing the assistant air control valve 32 through the ASHISU assistant air installation path 33 by making pressurized inhalation air into assistant air at the time of supercharge, it introduces the inhalation air of atmospheric pressure as assistant air through the assistant air supply path 31 at the time of un-supercharging.

[0027] And while the assistant air supply path 31 branches on the way to the 1st and 2nd branching assistant air supply paths 31a and 31b and assistant air is supplied to each fuel injection valves 5a and 5b by the side of the 1st bank P through 1st branching assistant air passage 31a, assistant air is supplied to each fuel injection valves 5a and 5b by the side of the 2nd bank Q through 2nd branching assistant air supply path 31b. In addition, check valves 34 and 35 are interposed in the 1st and 2nd branching assistant air supply paths 31a and 31b, respectively.

[0028] each -- the exhaust gas discharged by the exhaust air port 4 is discharged in atmospheric air through a flueway 36 from the combustion chamber 3 of gas column #1-#6. In addition, the catalytic converter 37 for purifying exhaust gas is interposed in the flueway 36.

[0029] an exhaust-gas temperature is fallen -- making -- an antiknock property -- raising (generating of knocking being controlled) -- in order to reduce an NOx yield, the EGR system which makes an inhalation-of-air system flow back by making a part of exhaust gas into EGR gas is formed. The 1st EGR path 38 which makes the common inhalation-of-air path 12 of the downstream specifically flow back [catalytic converter / 37] from an intercooler 17 by making the exhaust gas in the flueway 36 of the upstream into EGR gas at the time of un-supercharging is formed, and the 1st EGR valve 39 for adjusting the amount of EGR(s) is interposed in this 1st EGR path 38.

[0030] Furthermore, the 2nd EGR path 41 which makes the common inhalation-of-air path 12 of the upstream flow back from the mechanical supercharger 16 is formed from the catalytic converter 37 by making the exhaust gas in the flueway 36 of the downstream into EGR gas at the time of supercharge. And the carbon trap 51 which sees to an EGR gas flow direction and removes the carbon in EGR gas sequentially from the upstream, EGR cooler 52 which cools EGR gas, and the 2nd EGR valve 42 which adjusts the amount of EGR gas (EGR rate) are interposed in this 2nd EGR path 41. Here, the 2nd EGR valve 42 can change free according to the signal impressed from a control unit 10 so that it may explain later, the appending rate, i.e., the EGR rate, of EGR gas over an inhalation air content. In addition, that supply of the EGR gas to an inhalation-of-air system can be stopped has the natural 2nd EGR valve 42.

[0031] A control unit 10 is a synthetic control unit of the engine VE including the "inhalation-of-air valve-opening close timing control means" and the "EGR control means" which were indicated by the claim, a "supercharge control means", and the "Air Fuel Ratio Control means" which consists of a microcomputer. The inhalation air content detected by the intake air flow sensor 14, the inhalation air temperature detected by the 1st intake temperature sensor 45, The throttle opening detected by the

throttle sensor 46 (engine load), The temperature of the pressurization air breathed out, the inhalation air temperature 16, i.e., the supercharger, of a supercharger lower stream of a river detected by the 2nd intake temperature sensor 47 (This is hereafter called S/C discharge temperature for convenience), the inhalation air temperature of the intercooler lower stream of a river detected by the 3rd and 4th intake temperature sensor 48 and 49, Various control of Engine VE is performed by making into control information various information, such as an engine speed detected by the engine-speed sensor (not shown), and an exhaust-gas temperature detected by the exhaust air temperature sensor (not shown).
[0032] However, since general engine control by the control unit 10 is performed by the ordinary control technique known well and it is not just going to make it into the summary of the invention in this application again, the explanation is omitted, and below, only the inhalation-of-air valve-opening close timing control and EGR control in connection with the summary of the invention in this application, supercharge control, and Air Fuel Ratio Control are explained, referring to drawing 1 and drawing 2 suitably. That is, in Engine VE, based on an engine speed, a S/C discharge temperature, and an exhaust-gas temperature, a control unit 10 controls preferably the closing motion timing, the EGR rate, the amount of pressurization air relief, and air-fuel ratio of inlet valves 1a and 1b, it raises engine power and the fuel consumption engine performance, preventing generating of knocking by all operating range, and holds a S/C discharge temperature and an exhaust-gas temperature in tolerance.
[0033] Specifically, the 1st and 2nd fuel injection valve 5a and 5b, VVT9, a relief valve 20, and the 2nd EGR valve 42 are controlled by the following technique.
(1) In the operating range (supercharge field) to which supercharge is performed by the supercharger 16 at least, in a low-speed field, the 1st and 2nd inlet valve 1a and 1b sees by the crank angle, an inhalation-of-air line is closed by VVT9 to the comparatively late timing after a bottom dead point (after [a bottom dead point] 60degreeC.A. like [For example,] an inhalation-of-air line), and inlet-valve ****** operation is performed. Although an effective compression ratio becomes small at this time, charge pressure becomes high at this rate, and an inhalation-of-air charging efficiency is fully secured. Since the effective compression ratio of the gaseous mixture in a combustion chamber 3 becomes small at this time, the temperature rise by compression of gaseous mixture becomes small. For this reason, the temperature of the gaseous mixture at the time of ignition becomes comparatively low, and an antiknock property is raised. In addition, since a pumping loss is reduced by this inlet-valve ****** operation, the fuel consumption engine performance is also raised. In this case, although EGR gas may be supplied to an inhalation-of-air system, it may not carry out or whichever is sufficient, when supplying EGR gas, in order to make reduction of the amount of new mind inhalation as small as possible, it is desirable to make small the amount of EGR gas or an EGR rate. In addition, although a S/C discharge temperature will also rise with the rise of charge pressure, since charge pressure is low from the first in this low-speed field, there is no possibility that a S/C discharge temperature may reach a tolerance discharge temperature.
[0034] (2) When an engine speed goes up gradually at the time of operation in this low-speed field, an exhaust-gas temperature will rise in connection with this, but when an exhaust-gas temperature rises to a predetermined tolerance exhaust-gas temperature, an EGR rate is raised only for the specified quantity in the shape of a step by enlarging opening of the 2nd EGR valve 42. In addition, when EGR gas is not supplied to an inhalation-of-air system in the aforementioned condition of (1), supply of EGR gas will be started from this time. Thus, since the combustion temperature of the gaseous mixture in a combustion chamber 3 will fall if an EGR rate is raised, an exhaust-gas temperature also falls, and an exhaust-gas temperature is held below at a tolerance exhaust-gas temperature. Therefore, an exhaust-gas temperature can be held below to a tolerance exhaust-gas temperature, without causing fuel consumption performance degradation, and the dependability of a flueway 36 or a catalytic converter 37 is raised. Moreover, an antiknock property is raised by the rise of an EGR rate. In this case, after an EGR rate is raised in the shape of a step, it is desirable to make an EGR rate increase gradually with the rise of an engine speed. In addition, you may make it an exhaust-gas temperature make an EGR rate increase from the field approaching a tolerance exhaust-gas temperature. Thus, the rise of an exhaust-gas temperature can be controlled much more effectively by making an EGR rate increase according to an engine speed.

[0035] (3) Moreover, although charge pressure will go up in connection with this and a S/C discharge temperature will rise if an engine speed goes up gradually at the time of operation in a low-speed field When a S/C discharge temperature rises to a predetermined tolerance discharge temperature, it is closed by VVT9 to timing (after [a bottom dead point] 30degreeC.A. like [For example,] an inhalation-of-air line) earlier than the case where the 1st and 2nd inlet valve 1a and 1b is inlet-valve ****** operation, and inlet-valve ****** operation is performed. Since an effective compression ratio becomes large at this time, charge pressure becomes low at this rate, and a S/C discharge temperature falls. Therefore, a S/C discharge temperature is held below at a tolerance discharge temperature. In this case, control of knocking will be performed by the fall of the combustion temperature by EGR, and the increment in the valve-opening overlap between an inlet valve and an exhaust valve. In addition, "inlet-valve ****** operation" is the meaning that inlet valves 1a and 1b are closed to timing earlier than the case of inlet-valve ****** operation, and is not the meaning that an inlet valve is closed to timing earlier than the conventional ordinary engine here.

[0036] (4) When an engine speed goes up further from the above-mentioned condition of (2) and an exhaust-gas temperature rises to a tolerance exhaust-gas temperature again, an air-fuel ratio is changed into a rich side by making the fuel oil consumption of the 1st and 2nd fuel injection valve 5a and 5b increase. An exhaust-gas temperature is reduced by this and it is held below at a tolerance exhaust-gas temperature. Thus, since an exhaust-gas temperature is reduced by raising an EGR rate first, it begins when it changes into the condition that an exhaust-gas temperature cannot be held below to a tolerance exhaust-gas temperature any longer depending on raising an EGR rate, and he is trying to change an air-fuel ratio into a rich side, rich-ization of an unnecessary air-fuel ratio is avoided, and the fuel consumption engine performance is raised.

[0037] (5) When an engine speed goes up further from the above-mentioned condition of (3) and a S/C discharge temperature rises to a tolerance discharge temperature again, the pressurization air of an intercooler lower stream of a river is made to relieve through the bypass inhalation-of-air path 18 by opening a relief valve 20 by the common inhalation-of-air path 12 of a supercharge style on board. Charge pressure is reduced by this and a S/C discharge temperature is held below at a tolerance discharge temperature. Thus, since it is made to relieve pressurization air for the first time when it changes into the condition that a S/C discharge temperature cannot be reduced and a S/C discharge temperature cannot be held below to a tolerance discharge temperature any longer depending on inlet-valve ****** operation by performing inlet-valve ****** operation first, it can make the most of the capacity of a supercharger 16 by the large operating range, and engine power can fully be heightened.

[0038] Hereafter, referring to drawing 3 , about the case where regular gasoline is used as a fuel, when an engine speed goes up gradually from a pole low-speed field (almost idle field), the change property of an exhaust-gas temperature and a S/C discharge temperature when the above-mentioned control is performed etc. is explained. In drawing 3 , a tolerance exhaust-gas temperature and a tolerance discharge temperature are indicated to be T1 and T2, respectively, G1 (continuous line) shows the change property over the engine speed of a S/C discharge temperature, and H1 (continuous line) shows the change property over the engine speed of an exhaust-gas temperature. Moreover, G2 shows the change property over the engine speed of the S/C discharge temperature at the time of raising an EGR rate by inlet-valve ******, G3 shows the property over the engine speed of the S/C discharge temperature when not raising an EGR rate by inlet-valve ******, and G4 shows the property over the engine speed of the S/C discharge temperature at the time of raising an EGR rate by inlet-valve ******. Furthermore, H2 shows the change property over the engine speed of the exhaust-gas temperature at the time of raising an EGR rate by inlet-valve ******, H3 shows the property over the engine speed of the exhaust-gas temperature at the time of raising an EGR rate by inlet-valve ******, and H4 shows the property over the engine speed of the exhaust-gas temperature when not raising an EGR rate by inlet-valve ******.

[0039] If an engine speed goes up gradually from the condition (EGR rate = the case where it is 0 is included) that inlet-valve ****** operation is performed in a pole low-speed field, and the EGR rate is not raised as shown in drawing 3 , in connection with this, both an exhaust-gas temperature and a S/C discharge temperature will rise, but when an engine speed amounts to N1, an exhaust-gas temperature

reaches the tolerance exhaust-gas temperature T1 first. Thus, it is because the inclination for ignition timing to be comparatively set to a retard side since, as for an exhaust-gas temperature reaching tolerance first, regular gasoline with an antiknock property comparatively low as a fuel is used, for gaseous mixture to be in an afterburning condition for this reason, and for an exhaust-gas temperature to become high is strong. In addition, since inlet-valve ****** operation is performed for the engine speed in the one or less N field, an antiknock property is raised and generating of knocking is prevented effectively.

[0040] When an engine speed amounts to N1, an EGR rate is raised in the shape of a step, and the sudden fall of the exhaust-gas temperature is carried out. In this case, since the amount of new mind inhalation will decrease, in order to compensate with this only the part to which the EGR rate was raised, charge pressure is raised a little, and a S/C discharge temperature rises a little by this. In addition, since inlet-valve ****** operation is performed for an engine speed in the field of N1-N2 and an EGR rate is raised, an antiknock property is raised further and generating of knocking is prevented much more effectively.

[0041] If an engine speed goes up further from this condition, when an engine speed amounts to N2, a S/C discharge temperature reaches the tolerance discharge temperature T2, it changes to inlet-valve ****** operation at this time, and by this, charge pressure will fall and a S/C discharge temperature will carry out a sudden fall. At this time, an exhaust-gas temperature rises a little. In addition, generating of knocking of an engine speed in the field of N2-N3 with EGR gas is prevented. In this case, by already making an inlet valve into closing, since the valve-opening overlap between an inlet valve and an exhaust valve becomes large, the scavenging-air nature in a combustion chamber 3 is raised, and an antiknock property is raised by this. Moreover, in this field, since there are allowances in a S/C discharge temperature, it is desirable to make [many] the amount of EGR(s) and to raise an antiknock property.

[0042] If an engine speed furthermore goes up, when an engine speed amounts to N3, an exhaust-gas temperature will reach the tolerance exhaust-gas temperature T1 again, and an air-fuel ratio will be changed into a rich side at this time. In addition, since an air-fuel ratio is preferably adjusted so that an exhaust-gas temperature may not exceed T1, when an engine speed is higher than N3, an exhaust-gas temperature is held mostly T1. Thus, since rich-ization of an air-fuel ratio is performed in a high rotation field, the fuel consumption engine performance is raised.

[0043] If an engine speed furthermore goes up, when an engine speed amounts to N4, a S/C discharge temperature will reach the tolerance discharge temperature T2 again, and the pressurization air of an intercooler lower stream of a river will be relieved by the common inhalation-of-air path 12 of a supercharge style on board at this time. Here, since the amount of relief of pressurization air is preferably adjusted so that a S/C discharge temperature may not exceed T2, when an engine speed is higher than N4, a S/C discharge temperature is held exactly T2. Thus, since relief of pressurization air is performed in a high rotation field, the engine performance of a supercharger 16 can be demonstrated by the large operating range to the maximum extent, and engine power is heightened.

[0044] Thus, engine power can be heightened, preventing generating of knocking by all operating range, and the fuel consumption engine performance can be raised, and an exhaust-gas temperature and a S/C discharge temperature can be further held in tolerance.

[0045]

[Function and Effect of the Invention] According to the 1st invention, since inlet-valve ****** operation is performed in a low-speed field, the effective compression ratio of the gaseous mixture of a combustion chamber becomes small, and the temperature rise by compression of gaseous mixture becomes small. For this reason, the temperature of the gaseous mixture at the time of ignition becomes comparatively low, an antiknock property is raised, and generating of knocking is prevented. And since an EGR rate is raised when an engine speed goes up from this condition and an exhaust-gas temperature rises to a predetermined tolerance exhaust-gas temperature, an exhaust-gas temperature falls and it is held below at a tolerance exhaust-gas temperature. Therefore, an exhaust-gas temperature can be held in tolerance, without causing fuel consumption performance degradation, and the dependability of an

exhaust air system can be raised. Moreover, since inlet-valve ****** operation is performed when an engine speed goes up and the discharge temperature of a supercharger rises to a predetermined tolerance discharge temperature, an effective compression ratio becomes large, charge pressure becomes low at this rate, a discharge temperature falls, and it is held below at a tolerance discharge temperature. Therefore, a discharge temperature can be held in tolerance, demonstrating the capacity of a supercharger to the maximum extent, and engine power can be heightened.

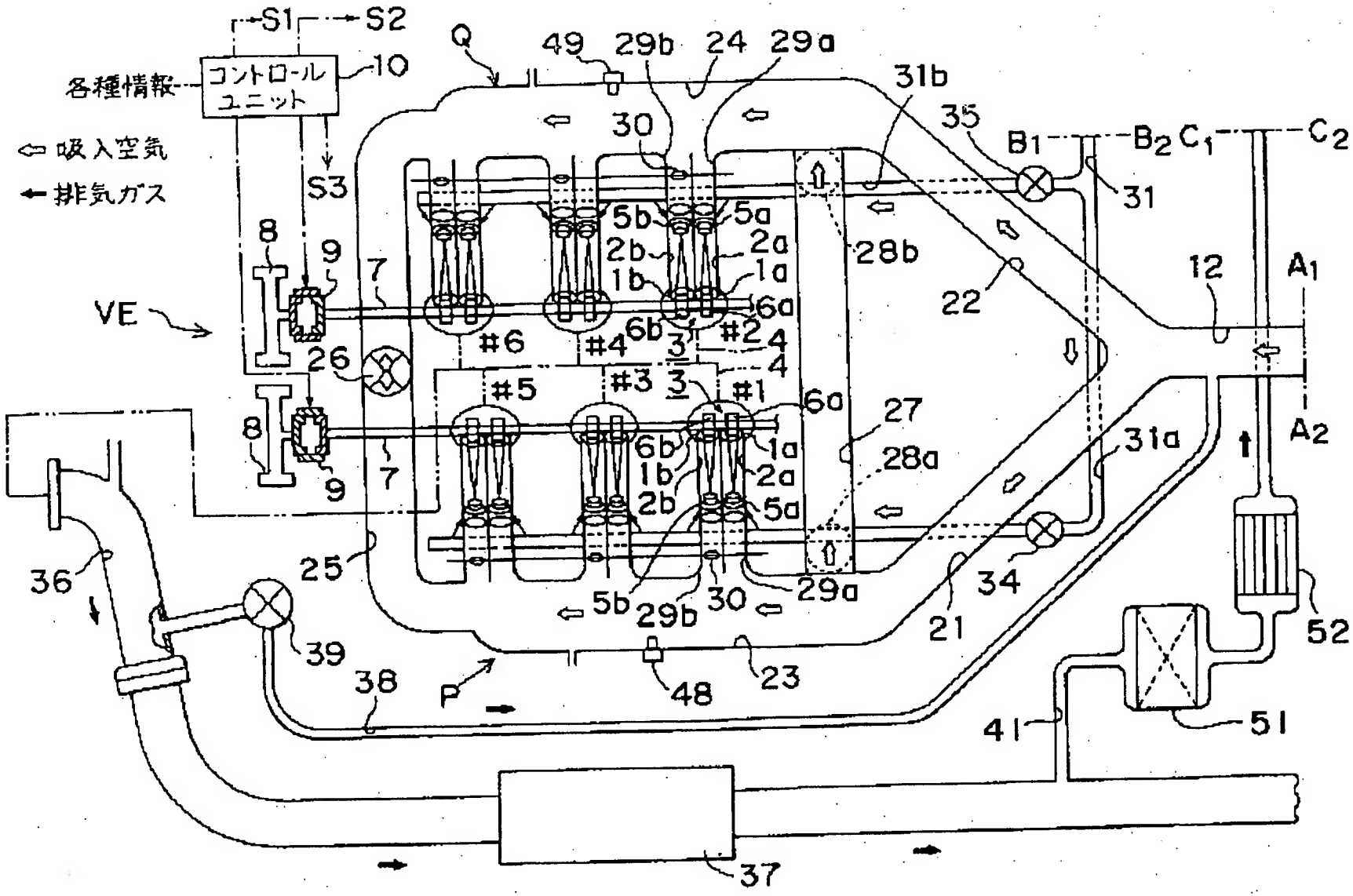
[0046] According to the 2nd invention, the same operation and effectiveness as the 1st invention are acquired fundamentally. Furthermore, when an engine speed goes up and an exhaust-gas temperature rises to a tolerance exhaust-gas temperature again, an air-fuel ratio is changed into a rich side, an exhaust-gas temperature is reduced by this, and it is held below at a tolerance exhaust-gas temperature. Therefore, since he is trying to change an air-fuel ratio into a rich side for the first time when it changes into the condition that an exhaust-gas temperature cannot be reduced and an exhaust-gas temperature cannot be held in tolerance by this by raising an EGR rate first, rich-ization of an unnecessary air-fuel ratio is avoided, and the fuel consumption engine performance is raised. Moreover, when an engine speed goes up and a discharge temperature rises to a tolerance discharge temperature again, the pressurization air of a supercharger lower stream of a river is made to relieve by the inhalation-of-air path of a supercharge style on board, charge pressure is reduced by this, and a discharge temperature is held below at a tolerance discharge temperature. Therefore, since he is trying to make pressurization air relieve for the first time when it changes into the condition that a discharge temperature cannot be reduced and a discharge temperature cannot be held in tolerance by this by performing inlet-valve ****** operation first, it can make the most of the capacity of a supercharger by the large operating range, and engine power can be heightened.

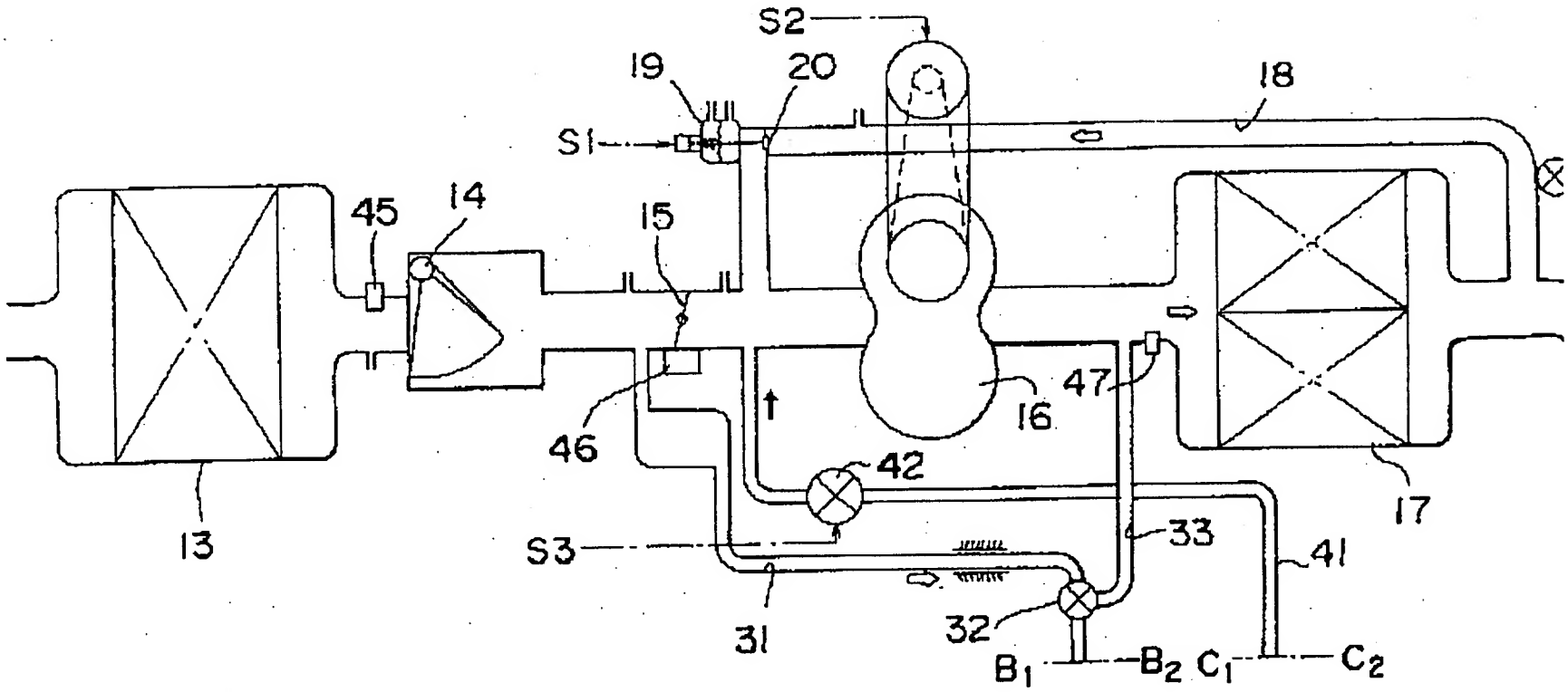
[0047] According to the 3rd invention, the same operation and effectiveness as the 1st or 2nd invention are acquired fundamentally. Furthermore, since regular gasoline with a comparatively low antiknock property is used as a fuel, an exhaust-gas temperature becomes comparatively high. For this reason, when an engine speed goes up from a low-speed field, an exhaust-gas temperature will reach a tolerance exhaust-gas temperature first, and a discharge temperature will reach a tolerance discharge temperature in next. Therefore, since the EGR rate is already raised in case a discharge temperature reaches a tolerance discharge temperature and inlet-valve ****** operation is performed, an antiknock property is fully raised by this and generating of knocking is prevented. In addition, since an EGR rate is not raised until an exhaust-gas temperature reaches tolerance from this time when the direction of a discharge temperature reaches tolerance previously, using a high octane gasoline as a fuel, an antiknock property will fall a little.

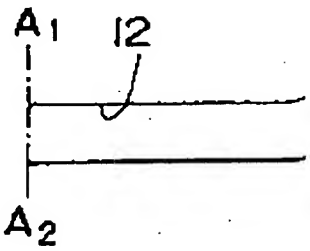
[0048] According to the 4th invention, the same operation and effectiveness as any one of the 1st - the 3rd invention are acquired fundamentally. Furthermore, since supply of the EGR gas to an inhalation-of-air system is suspended in a low-speed field, the amount of new mind inhalation increases and engine power is heightened.

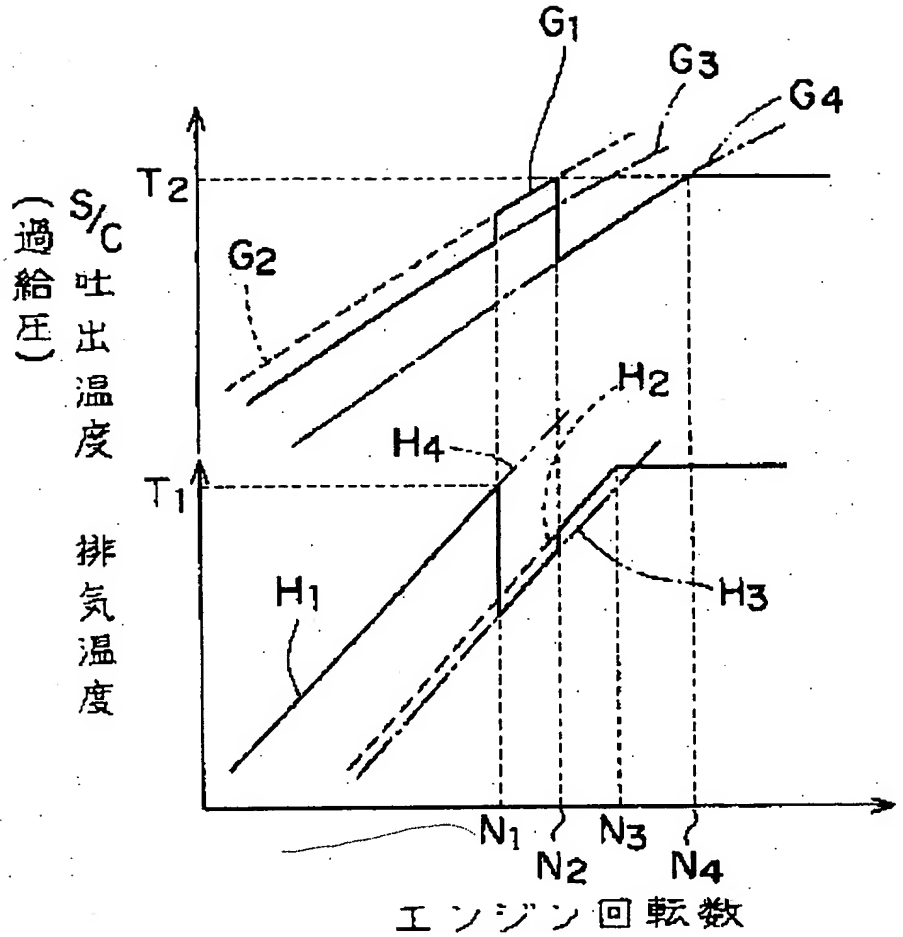
[0049] According to the 5th invention, the same operation and effectiveness as any one of the 1st - the 4th invention are acquired fundamentally. Furthermore, since an EGR rate is raised with the rise of an engine speed, the rise of an exhaust-gas temperature is controlled effectively.

[Translation done.]


S1
S2
Q
49
29b
24
29a
31b
35
B1
B2
C1
C2
各種情報
コントロールユニット
10
⇦ 吸入空気
← 排気ガス
S3
30
31
5b
5a
2b
2a
1b
1a
6a
28b
22
12
A1
8
9
7
VE
#6
#4
6b
#2
3
4
26
#5
#3
#1
27
A2
31a
28a
6b
1b
2b
1a
2a
5a
36
25
34
21
52
5b
29b
30
29a
39
38
P
48
23
41
51
37


S2
19
20
18
S1
45
14
15
16
47
46
42
17
13
S3
33
41
31
32
B1
B2
C1
C2


A1
12
A2


G1
G3
G4
T2
S/C
(過給圧)
吐出温度
G2
H2
H4
T1
H1
H3
排気温度
N1
N2
N3
N4
エンジン回転数